

## DIPLOMA THESIS REVIEW

**Author:** Bc. Daniel Fišer

**Name:** Inference of State Invariants for Domain-independent Planning

**The review was elaborated by:** MSc. Alexander Shleyfman, PhD candidate

Daniel Fišer's diploma thesis focuses on the field of Artificial Intelligence (AI), in particular, inference of state invariants for STRIPS world models in domain-independent planning. The presented work is partially based on the "Concise finite-domain representations for PDDL planning" paper [M. Helmert, 2009], and extends and analyses one particular type of state invariants called *mutexes*. The Thesis introduces two new types of mutex invariants and presents a thorough analysis of their properties and relations between them. In addition, the author presents a complexity analysis for both of the introduced mutex invariants, showing the inference of maximum size mutex is PSPACE-Complete for the first, and NP-Complete for the second. Using those theoretical results the author introduces three new mutex inference algorithms, and compares them with two state-of-the-art algorithms over the standard benchmarks of the International Planning Competition (IPC), showing the advantages and the disadvantages of those different approaches.

The Thesis is divided into five chapters. The first Chapter is dedicated to introduction of the work, and the second one gives a solid overview of the related literature. The next two chapters of the Thesis constitute the main contribution: Chapter 3 – where all theoretical results are obtained, and Chapter 4 – which presents the empirical evaluation of the algorithms in hand, and presents a few promising directions for the future work. In the last Chapter, the work summary and a short discussion are given. In addition, the Thesis has an Appendix which presents additional figures for the experiments that were done. The work is well motivated and is of high quality, it has a thorough survey of the related literature, solid theoretical proofs, and interesting experimental results.

The Thesis diploma is well written and complete. The structure is chosen appropriately: chapters are well organized, and have a good flow. The student aptly quotes the relevant literature and builds the theory upon it. The theoretical part is well founded, and has a solid mathematical structure. The experiments part looks very convincing and promising. The student chose a difficult but very important topic and was done an excellent research on it. This Thesis constitutes a contribution which (in my opinion), with small adjustments, can be presented in a scientific conference or published in an appropriate peer reviewed journal. The work assignment has been fulfilled in all points.

The work **meets the requirements for a Thesis** of an Excellent quality. I evaluate the diploma thesis by the mark **Excellent (A)**.

I would like to present the following questions:

1. As we can see in Chapter 4, the *fd* configuration is the fastest of the presented algorithms. However, it discovers only mutexes of the size two. On the other hand, the *fa* configuration, that is much slower than *fd*, produces a much larger set of mutexes. My question is, can one combine those approaches, to save some running time? The mutexes discovered by *fd*, can be transformed into linear equations and added as conditions to the initial ILP that is solved by *fa*, thus reducing the amount of ILPs that should be solved.
2. As I understand, one of the main motivations for this work was the grounding of PDDL task to a STRIPS problem. Can you estimate what would be the impact of implementing this approach in one of the state-of-the-art planners? It looks that this may reduce the search effort, at least in some of the IPC domains. Are there some theoretical guarantees?

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